ENERGY FACT SHEET

ENERGY CONSERVATION INSULATION FACTS

How Does Insulation Work?

Heat flows from an area of high temperature to an area of lower temperature – or from a warmer to a cooler area. This “heat transfer” takes place from those living spaces in your home adjacent to unheated attics, garages, and basements, as well as those directly adjacent to the outdoors.

Thus, during all seasons of the year, heat is flowing through the building “envelope” – the attic, walls, and floors – from a warmer place to a cooler place. The result is that in winter, heat in your home flows out through the building envelope to the outdoors, and in summer, heat from outdoors flows into rooms you are trying to keep cool. Insulation decreases this heat transfer by providing a barrier that reduces the flow of heat.

How Much Insulation Is Necessary?

For Maine, the IECC Building Envelope Requirements for compliance has the following minimum R Values:

R-49 CEILINGS, including slopes, which face outdoors or unheated spaces

R-21 WALLS which face outdoors or unheated spaces

R-3 (U=.35) WINDOWS

R-21 FLOORS over unheated spaces

R-11 FOUNDATION WALLS (All counties except Aroostook) – that enclose below grade heated spaces (top of foundation to design frost line)

R-18 FOUNDATION WALLS (Aroostook County) – that enclose below grade heated spaces (top of foundation to design frost line)

R-13 SLAB-ON-GRADE FLOORS (Southern Maine) – either 1) around perimeter from top of slab to design frost line or; 2) around perimeter and horizontally beneath slab for a distance equal to design frost-line depth

If you are retrofitting an older house, it may not be possible to achieve the recommended levels of insulation in all areas. However, you may be able to save an equivalent amount of energy by increasing the insulation levels in areas where this is practical.

U.S. DEPARTMENT OF ENERGY
STATE ENERGY PROGRAM
MAINE

Maine State Energy Program
Public Utilities Commission ● 242 State House Station ● Augusta ● Maine 04333-0018 ● Tel: (207) 287-3349 ● Fax: (207) 287-1039

NOTE: The preceding insulation standards are recommended for single and two-family residential construction. (Exemptions include: owner built, owner occupied, contractor built for owner-occupied, summer camps and log homes.) The same standards also apply to multi family construction including all new construction, additions, & substantial renovations. Additional standards binding on multi family construction are: ASHRAE 90.2-1994 on multi family low rise (3 or fewer stories); ASHRAE 90.1-2001 and 62-2001 on multi family high rise (more than 3 stories).

For commercial and institutional buildings, Maine Law mandates compliance with ASHRAE standards 90.1-2001 (envelope) and ASHRAE 62-2001 (ventilation). These standards are binding on all new constructions and additions (including speculative and rental). Industrial buildings (manufacturing) are exempt.

If you have any questions about these standards, call the PUC Energy Program Division (287-3349).

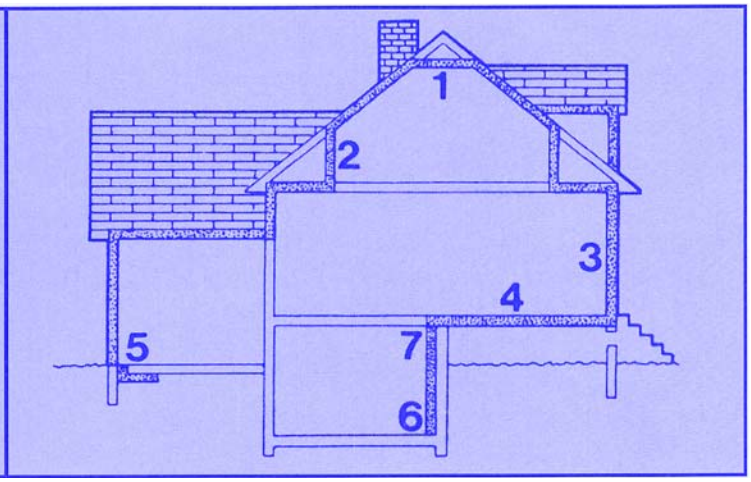
Form	Method of Installation	Where Applicable	Advantages
Blankets: Batts or Rolls Fiberglass* Rock wool	Fitted between studs, joists and beams	All unfinished walls, floors and ceilings	Do-it-yourself Suited for standard stud and joist spacing, which is relatively free from obstructions
Loose-Fill Vermiculite or Perlite**	Poured in		
Loose-Fill (blown-in) or Spray-applied Rock wool Fiberglass Cellulose Polyurethane foam	Blown into place or spray applied by special equipment	Enclosed existing wall cavities or open new wall cavities Unfinished attic floors and hard to reach places	Commonly used insulation for retrofits (adding insultation to existing finished areas) Good for irregularly shaped areas and around obstructions
Rigid Insultation Extruded polystyrene foam (XPS) Expanded polystyrene foam (EPS or beadboard) Polyurethane foam Polyisocyanurate foam	Interior applications: Must be covered with 1/2-inch gypsum board or other building-code approved material for fire safety Exterior applications: Must be covered with weather-proof facing	Basement walls Exterior walls under finishing (Some foam boards include a foil facing which will act as a vapor retarder. Please read the discussion about where to place, or not to place, a vapor retarder.) Unvented low slope roofs	High insulating value for relatively little thickness Can block thermal short circuits when installed continuously over frames or joists.
Reflective Systems Foil-faced paper Foil-faced polyethylene bubbles Foil-faced plastic film Foil-faced cardboard	Foils, films, or papers: Fitted between wood-frame studs, joists, and beams	Unfinished ceilings, walls, and floors	Do-it-yourself All suitable for framing at standard spacing. Bubble-form suitable if framing is irregular or if obstructions are present Effectiveness depends on spacing and heat flow direction

*The movement of air may have a greater impact on reducing the insulating value of fiberglass. Therefore, it is advisable to add an air barrier during installation.
**Not currently used for home insulation, but may be found in older homes.

Where is Insulation Necessary?

All surfaces exposed to unheated spaces should be insulated. Specifically, insulation should be installed in or on:

1. Ceilings with cold spaces above
2. Rafters and "knee" walls of a finished attic
3. Exterior walls; walls between heated and unheated spaces; dormer walls
4. Floors over outside or unheated spaces
5. Perimeter of a concrete floor slab close to grade level
6. Walls of finished or heated basement
7. Top of foundation or basement wall



What about Vapor Barriers?

Being a gas, water vapor is always present in air. Relative humidity is the amount in the air compared to the maximum amount possible, expressed as a percentage. The ability of air to hold water vapor decreases as the temperature drops. If the temperature drops far enough, the mount possible drops to the amount present. The relative humidity at this temperature is 100%. This temperature is called the dew point, because it is the temperature at which water vapor begins to be squeezed (condensed) out of the air as dew.

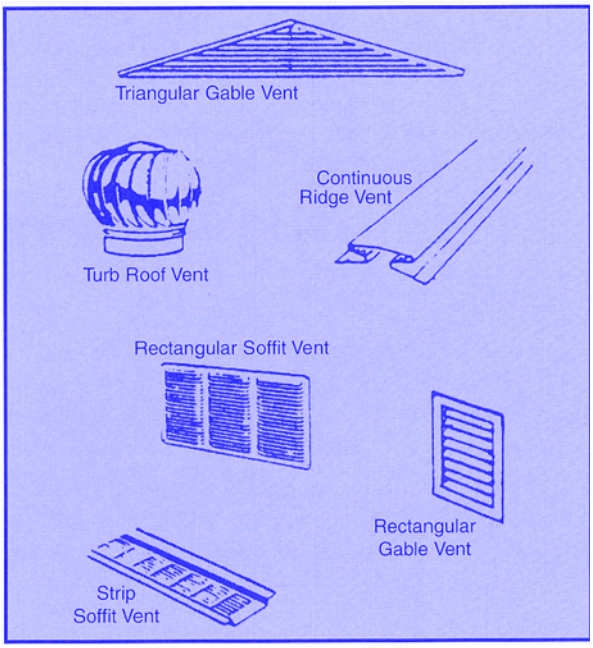
When building a new house, a good, continuous polyethylene vapor barrier is strongly recommended.

In insulating older homes, the question is often asked, do I need a vapor barrier? The answer depends on what conditions exist in the building. **It is always good insurance to use a vapor barrier, if it is possible.** However, some conditions make a vapor barrier more important than others. In insulating older homes, the following are some of the factors that influence the need for vapor barriers.

1. Size of the house – The larger the house, the more surface area the moisture has to pass through and the slower the flow of moisture through these larger areas. In small houses (less than 1000 sq. ft.) it is generally more important to install a vapor barrier than in a large one. This is because there is less surface area that the moisture has to pass through. This is assuming that the same amount of water vapor is present in both sizes of house;

2. Quality of construction – Generally a tight, well-built house has less air leakage through the structure and less moisture is carried off through natural ventilation. Therefore, tightly build houses require a vapor barrier more than loose, open construction;

3. Humidity level – The higher the inside humidity, the more moisture will pass to the outside, resulting in greater need for a vapor barrier. The amount of moisture produced in the house and the tightness of construction greatly influence the degree of humidity within the house. Generally humidity in the 20% to 40% range provide comfortable living conditions. Maintaining high humidity will result in surface condensation and more moisture problems. The average family of four adds about 6 gallons of water to the air within the house in a 24 hour period. The number of occupants, venting of clothes dryers, gas fired appliances, amount of cooking, number of houseplants, wet basements and crawl spaces, all can contribute moisture in the home;



4. Tightness of the inside surface – Certain types of building construction are more resistant to moisture flow than others. Table 2 shows some of the building materials that offer more resistance to the flow of moisture;

5. Tightness of the outside – A tight exterior traps moisture in exposed wall sections. Most outside coverings on buildings provide a high degree of resistance to moisture flow. Heavy paint coating aluminum or vinyl sidings are much more impermeable to water vapor flow than wood shingles or stained surface treatments; and,

6. Amount of ventilation – A properly installed vapor barrier is the primary form of moisture protection in walls. Roofs, attics, and crawl spaces, however, require a higher level of protection. Using a continuous vapor barrier and ventilating the building sections directly behind it can achieve this. When outside air is introduced through vents, these openings must be properly sized, placed, and installed for optimal performance. If any moisture enters roof cavities and attic spaces, it must be carried out of the building by air moving through vented openings. If the moisture is not removed, it may condense when it contacts the cooler roof sheathing and then drip back into the roof insulation. Good ventilation is particularly important in attic/ceiling areas. Ventilation areas should be equal to 1/150 of the attic area. If an adequate vapor barrier is present, this ratio can be reduced to 1/300. It is not possible to provide the proper amount of free vent opening, power ventilation, equipment may be installed. Low soffit vents in combination with high ridge or gable vents will provide the best ventilation.

Vapor barriers are only effective if the material forms a complete (balloon like) envelope on the inside of the building. Holes and other openings in the vapor barrier should be sealed to reduce moisture flowing to the outside. In installing vapor barriers, make sure that joints are sealed, either by using a pressure joint, tape or other material. Holes around outlet boxes, light fixtures, doors, and windows should be sealed to reduce the amount of moisture passing to the outside. If moisture should escape to the outside, provide an exterior cover to the building that offers relatively little resistance to the flow of moisture, or vent the exterior of the insulating materials to the outside by the use of wall or attic louvers. In new construction, a complete vapor barrier such as six mill polyethylene should be applied before the inside sheathing material is installed.

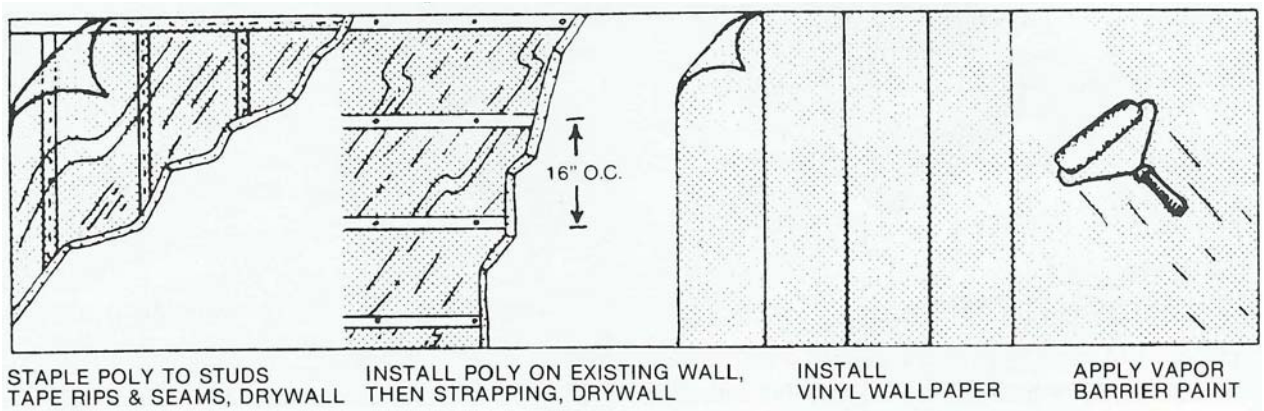
Moisture problems are most likely to occur: a) in walls and attics of high moisture areas, such as in bathrooms and un-vented kitchens and laundries; b) where the outside sheathing and finish of the exterior wall are of vapor impervious materials (the good and excellent vapor barriers in the illustration below); c) where a vapor barrier is not provided on the interior surfaces of exterior house walls; d) in ceilings without adequate attic ventilation; and e) whenever there is paint peeling on exterior surfaces. If you have evidence of any of these problems your choices are 1) produce less water vapor in the house; 2) block vapor that is unavoidable with vapor barrier; 3) ventilate moisture that penetrates the vapor barrier.

Air to air exchangers may be needed for proper ventilation in new, “energy tight: residential construction where air changes are less than .5 ach (air changes per hour). These can be placed strategically around the home, i.e., laundry room, kitchen, bathrooms, etc., or a larger model may be coupled with the central heating system.

Table 2. Vapor Barrier Characteristics of Common Building Materials

Poor	Wood, Sheetrock, air spaces, asphalt felt, plaster
Fair	Interior plywood, water based paints, polystyrene rigid board insulation
Good	Exterior plywood, oil base paints, vinyl wall coverings, roll roofing, asphalt impregnated felt or construction paper
Excellent	Polyethylene film (4 to 6 mil), metal foils, sheet metal and plastics

Possible Vapor Barrier Treatments for Walls



The Special Case of Foundation Insulation

The foundation of a house can be one of a home's major sources of heat loss. The thermal resistance (R-value) of exposed concrete walls is less than that of a double-glazed window. Therefore, whatever is under a house – a basement, concrete slab, or crawl space – should be insulated. Foundation walls should be insulated whenever a basement or crawl space is heated (or warmed by furnace, pipes, or ducts.

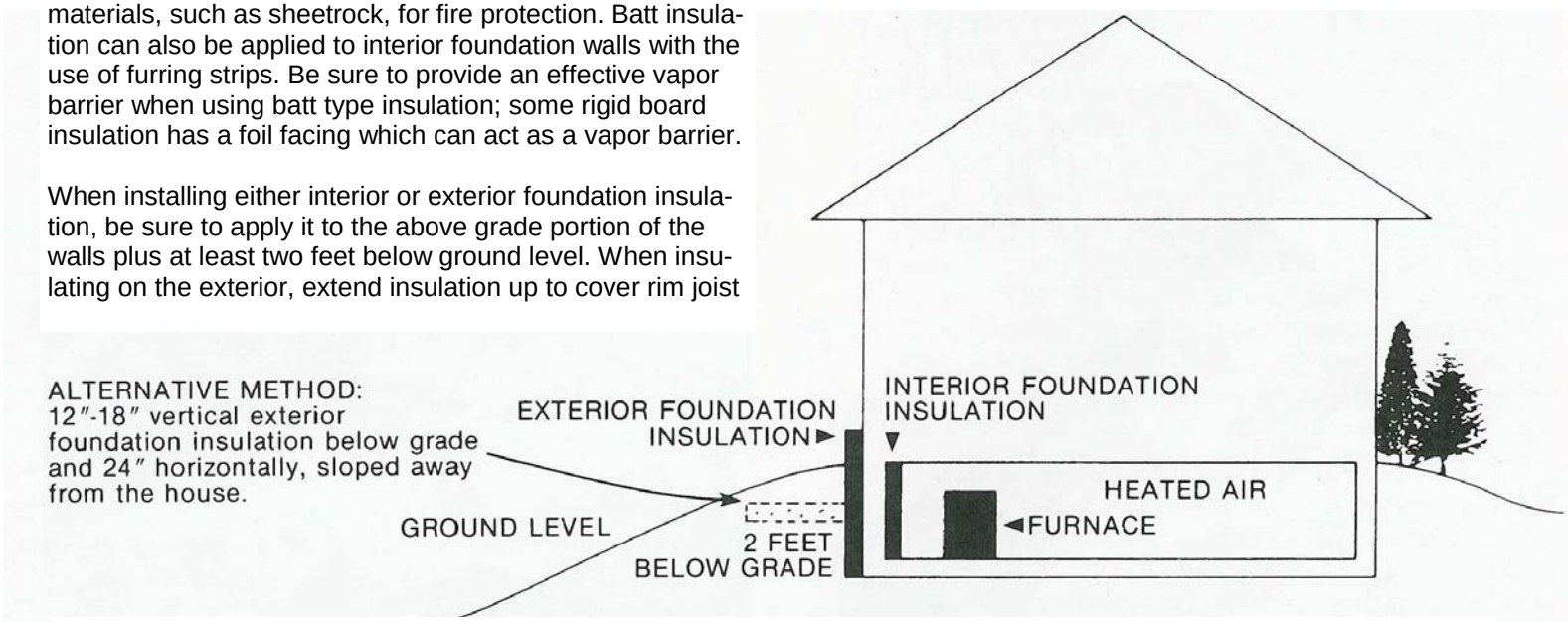
Basement foundation walls can be insulated either on the interior or exterior, although insulating on the exterior of walls is usually the best choice. Slabs must be insulated on the outside. See Table 1 for materials to use. The most common types are rigid foam boards such as rigid extruded polystyrene which ahs a high R-value and is a suitable material for exterior insulation. This material should not, however, be exposed to daylight.

Interior insulation doesn't require protection from the environment, but there are safeguards to keep in mind. Interior rigid board insulation must be covered with fire-resistant materials, such as sheetrock, for fire protection. Batt insulation can also be applied to interior foundation walls with the use of furring strips. Be sure to provide an effective vapor barrier when using batt type insulation; some rigid board insulation has a foil facing which can act as a vapor barrier.

When installing either interior or exterior foundation insulation, be sure to apply it to the above grade portion of the walls plus at least two feet below ground level. When insulating on the exterior, extend insulation up to cover rim joist and bottom plate. This will help insulate an otherwise difficult area.

Before you insulate your foundation walls, be sure to remedy any water seepage problems by improving drainage around the house. If the water/moisture situation can't be solved, don't insulate all the way to the bottom of the foundation. Also, in winter, cover any vents in heated crawl spaces with insulated covers.

Ventilation is necessary to reduce damaging moisture buildup in crawl spaces. The best approach combines a 6 mil polyethylene vapor barrier ground cover with properly sized and placed vents. Both plastic and metal operable vents are made for foundation walls. Awning-type basement windows are used where the crawl space is accessible. The vents should be located at the top of the walls with one at each corner of the foundation for cross ventilation. Air moving along the bottom of the floor joists absorbs moisture rising from the ground and carries it out of the space. This movement also tends to cool the first floor, so the joist cavities should be well insulated.



Assuring A Safe and Quality Installation

Manufacturer's recommendations should be followed carefully whenever insulation is installed. All insulations used and methods of installation should comply with applicable federal standards.

In particular:

1. Attic recessed light fixtures must not be covered by any insulation, unless UL approved for such use;
2. All exposed wiring should be checked; any exposed connections, frays, or cracks should be repaired. Contact a qualified electrician if in doubt about the connection of existing wiring.
3. Foam plastic insulations must be covered with ½" drywall or an equivalent 15 minute fire rated material, if used on the interior of a building, unless specifically approved by the State Fire Marshal;
4. When insulating, protect yourself from dust inhalation and fiber irritation by wearing long-sleeved, loose-fitting clothing, gloves, face-masks, and eye protection;
5. Combustible insulation should be kept at least 3" away from chimneys or other heat sources;
6. All permeable insulations will have a reduced R-value or become totally ineffective if subjected to large amounts of water. Damaged siding and leaking roofs should be repaired prior to insulating.

7. In walls, care should be taken to assure that the outside surface of the wall is more permeable than the inside surface. Special attention may be necessary if a material, such as un-perforated aluminum foil, foam board sheathing, oil based paints, or vinyl siding is used on the outside;

8. Crawl spaces beneath insulated floors should also be vented. At least one vent should be located on each side of the crawl space;

9. Be careful not to block any existing vents when adding insulation;

10. The insulation must fill the space exactly. Voids and gaps permit the infiltration of cold air into the building and allow convection currents to develop. Both of these processes can significantly reduce the effectiveness of the insulation.

When hiring a contractor, ask for references and check them out. Also get bids from several different contractors, but remember to *LOOK FOR QUALITY AS WELL AS PRICE.*

Maine law requires a contract for the installation of insulation. This law applies to residences of 3 or fewer living units. The contract must include:

1. The resistance factor (R-value) of the insulation per inch, and the thickness to be installed;

2. The type of insulation to be installed;

3. An estimate of the total area to be covered;

4. The degree of flammability of the insulation;

5. The method of installation to be used;

6. The type of ventilation to be installed (If none is installed, the contract shall so state.);

7. Whether or not the installed insulation is guaranteed against settling; and, if so, for how long and to what degree (If not guaranteed, the contract shall so state.);

8. The type of vapor barrier installed (If none is installed, the contract shall so state.);

9. The section of the dwelling to be insulated;

10. Any construction, reconstruction or structural changes required to install the insulation;

11. Any restoration, finishing or clean-up work to be performed following installation;

12. Provision of all warranties; and,

13. The name, business address and owner of the firm providing goods and services.

References

The Residential Conservation Service Installer's Guide, Document #SERI-SP-722-1289, 143 pages.

The Residential Conservation Service Inspector's Guide, 117 pages. Available for $10 each (including 3rd class postage) prepaid from: SERI Document Distribution Service, 1617 Colorado Blvd., Golden, C) 80401.

Handbook on Insulating Home for Energy Conservation, CGSB Standard #51-GP-42MP, July 1980, approx. 300 pages. Available for $28 from: Canadian General Standards Board, Ottawa, Ontario, Canada, K1A 1G6.

Criteria for the Installation of Energy Conservation Measures, (NBS Special Publication #606), by H.R. Trechsel and S.J. Launey, U.S. National Bureau of Standards, July 1981, 203 pages. Available for $6 from: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Rodale Product Testing Report, Insulation Materials, Rodale Press, Inc., 1982. 92 pages. Available for $10.00 from: Rodale Press Inc., 33 East Minor St., Emmaus, PA 18049.

DOE, Insulation Fact Sheet.